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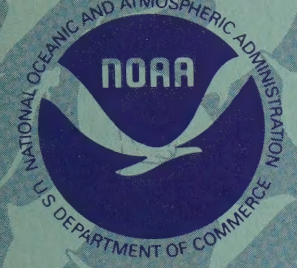

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PLANNING AND CONTROL OF RESEARCH AND DEVELOPMENT

by

David Mackett

ADMINISTRATIVE REPORT LJ-81-26

PLANNING AND CONTROL

OF

RESEARCH AND DEVELOPMENT PROGRAMS

by David Mackett

Program Planning Officer

Seminar material presented to

Cicimar, La Paz, Mexico

and the

Southwest Fisheries Center La Jolla, California

NOVEMBER 1981

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THIS PRESENTATION WILL -

- OVERVIEW SOME PLANNING CONCEPTS AND PRINCIPLES
- DISCUSS THE 3 SPECIES OF PLANNING
- INTRODUCE SOME PLANNING TOOLS USEFUL TO RESEARCHERS

A PLAN MAY BE DEFINED AS AN EXPLICIT STATEMENT OF

- OBJECTIVES,
- ACTIVITIES,
- RESOURCES, AND
- SCHEDULES

WHICH ARE REQUIRED TO ACHIEVE THE OBJECTIVES IN THE ENVIRONMENT ANTICIPATED.

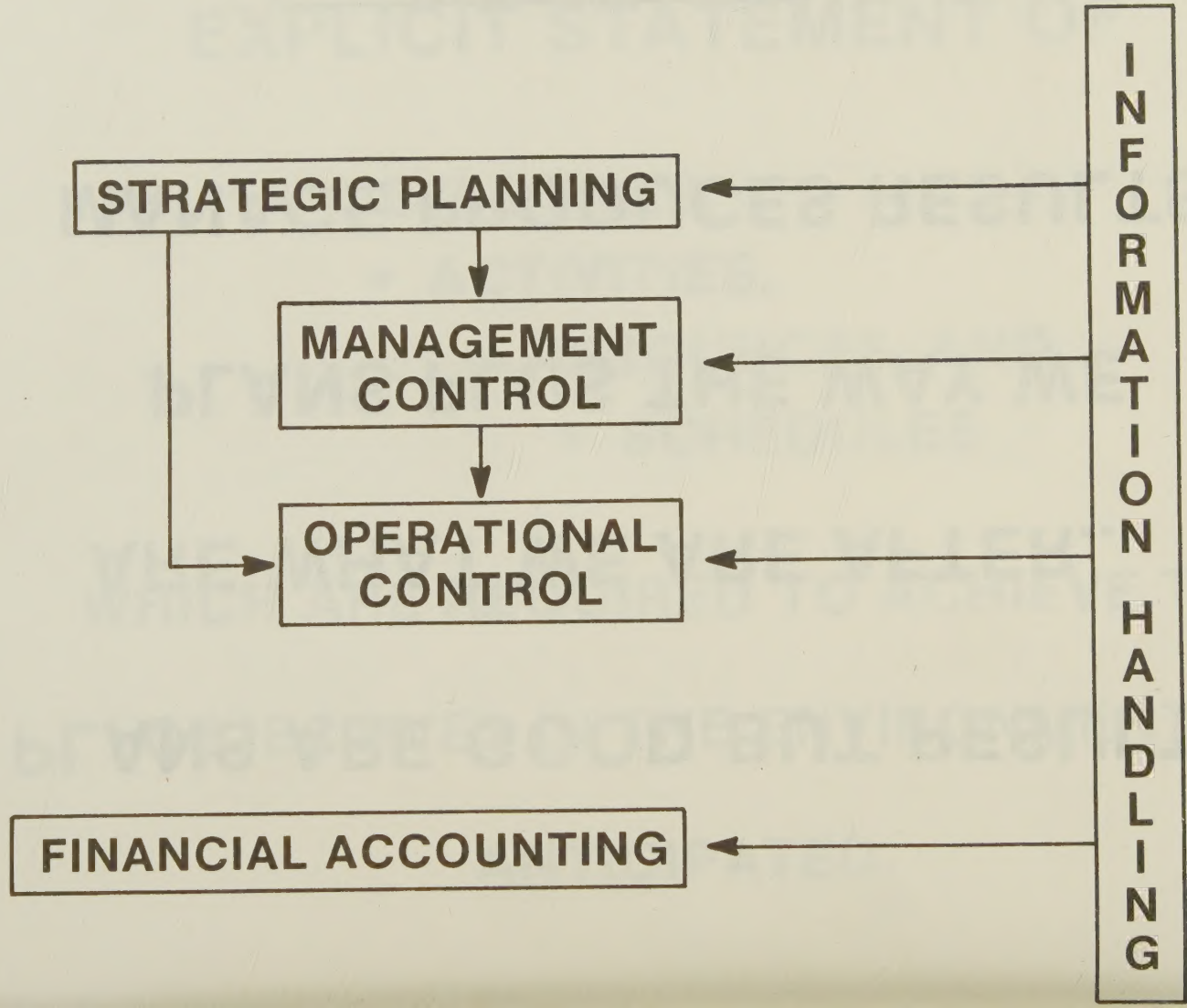
PLANS ARE GOOD BUT RESULTS

ARE WHAT WE ARE AFTER....

PLANS PLUS THE WAY WE

MANAGE PRODUCES RESULTS

ANTHONY'S FRAMEWORK FOR PLANNING AND CONTROL SYSTEMS PROPOSES THREE PROCESSES.



STRATEGIC PLANNING IS THE PROCESS OF DECIDING ON:

- OBJECTIVES
- CHANGES IN OBJECTIVES
- THE RESOURCES USED TO OBTAIN THE OBJECTIVES AND
- POLICIES THAT GOVERN ACQUISTION, USE AND DISPOSITION OF RESOURCES

MANAGEMENT CONTROL

THE PROCESS BY WHICH MANAGERS ASSURE THAT RESOURCES ARE OBTAINED AND USED EFFICIENTLY IN THE ACCOMPLISHMENT OF THE ORGANIZATIONS OBJECTIVES.

OPERATIONAL CONTROL

THE ACTIVITY OF ASSURING THAT SPECIFIC TASKS ARE CARRIED OUT EFFECTIVELY AND EFFICIENTLY.

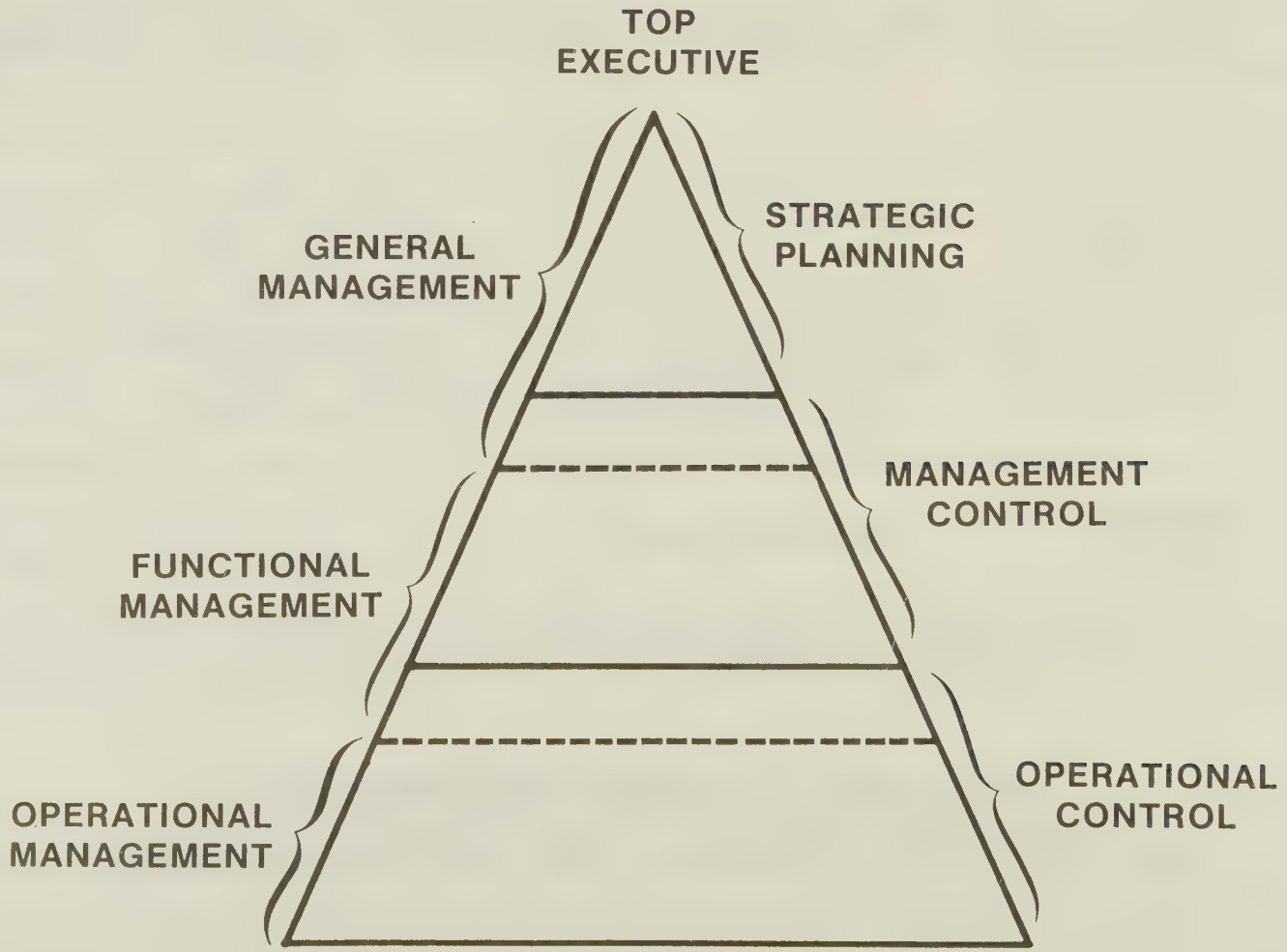
INFORMATION HANDLING

THE PROCESS OF COLLECTING, MANIPULATING AND TRANSMITTING INFORMATION, WHATEVER ITS USE IS TO BE.

FINANCIAL ACCOUNTING

THE PROCESS OF REPORTING FINANCIAL INFORMATION ABOUT THE ORGANIZATION TO THE OUTSIDE WORLD.

RELATIONSHIP OF MANAGEMENT HIERARCHY TO RESPONSIBILITIES FOR PLANNING AND CONTROL



COMPARISON OF THREE LEVELS OF PLANNING AND CONTROL

CHARACTERISTIC	STRATEGIC PLANNING	MANAGEMENT CONTROL	OPERATIONAL CONTROL
FOCUS OF PLANS	One aspect at a time	Whole organization	Single task or transaction
DEGREE OF STRUCTURE	Unstructured and irregular — each problem different	Rhythmic — prescribed procedures	Repetitious
NATURE OF INFORMATION	Tailormade for problem — more external and predictive, less accurate	Integrated — more internal and historical — more accurate	Tailormade to Operation — precise — often in real time
SOURCE DISCIPLINE	Economics	Social Psychology	Economics, Physical Sciences
PLANNING & CONTROL	Planning dominant but some control	Emphasis on both planning and control	All control
TIME HORIZON	Tends to be long	Weeks, months, years	Day to day

STRATEGIC PLANNING

ARE YOU DOING THE RIGHT THING?

TACTICAL & OPERATIONAL PLANNING

ARE YOU DOING IT RIGHT?

"More resources are wasted doing the wrong things efficiently than can ever be wasted doing the right things inefficiently."

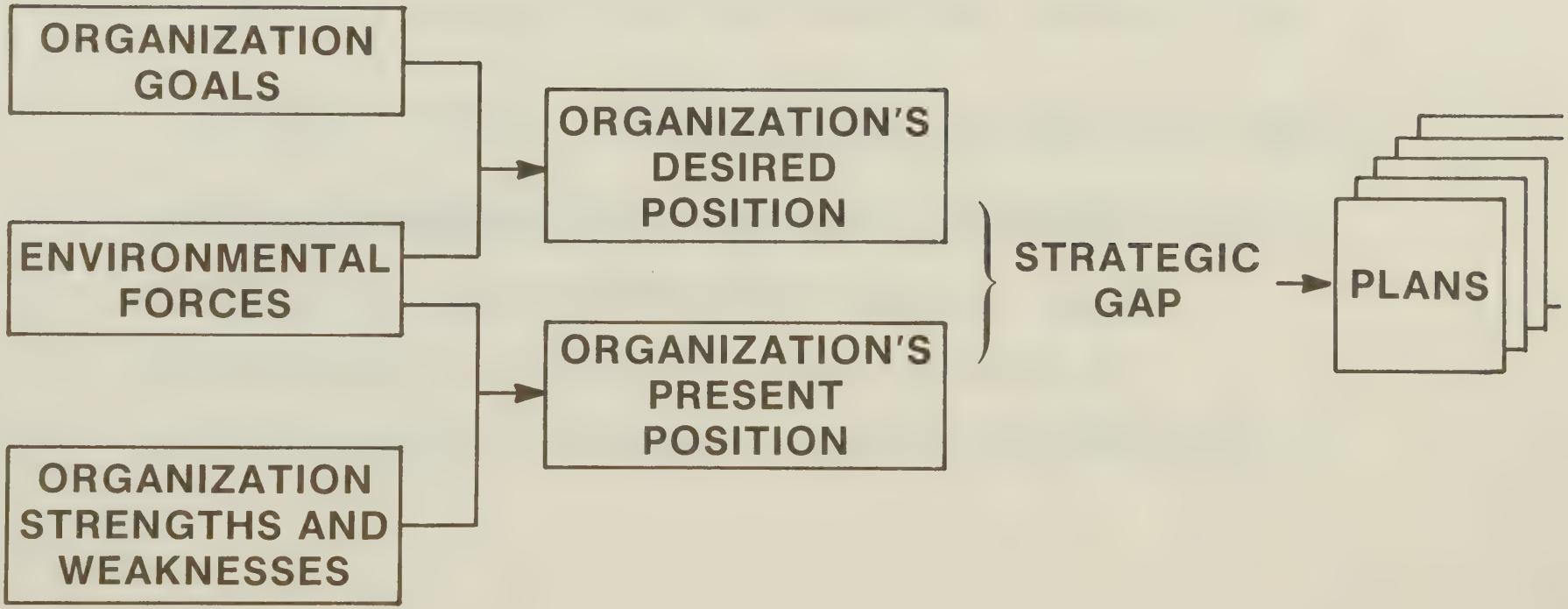
D. Novic 1973

"Long-range planning means evaluating immediate decisions with regard to long-run consequences, rather than constructing grand plans or big models."

Douglas B. Lee, Jr. 1973

THE STRATEGIC PLANNING CONCEPT

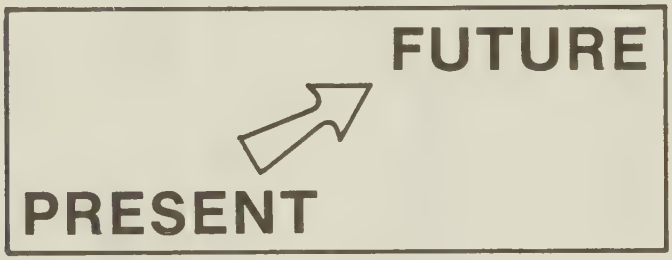
(Lewis Gerstner, Jr.)



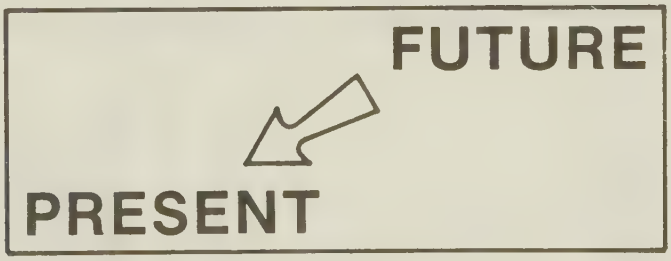
THE THREE PLANNING SPECIES

REACTIONARY PLANNING

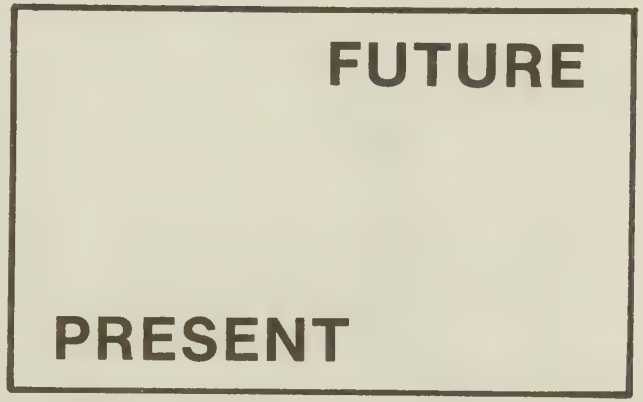
TREND PLANNING



GOALS PLANNING

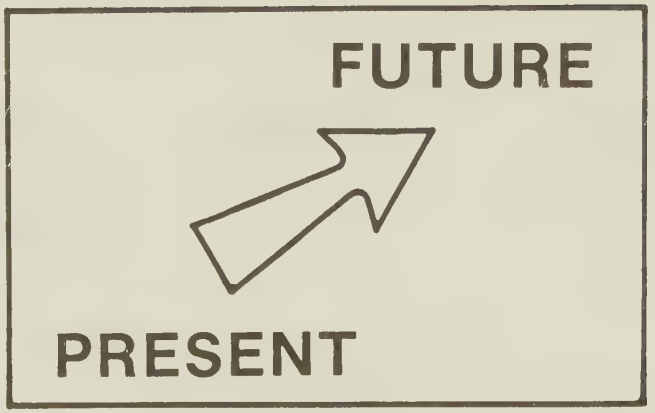


REACTIONARY PLANNING



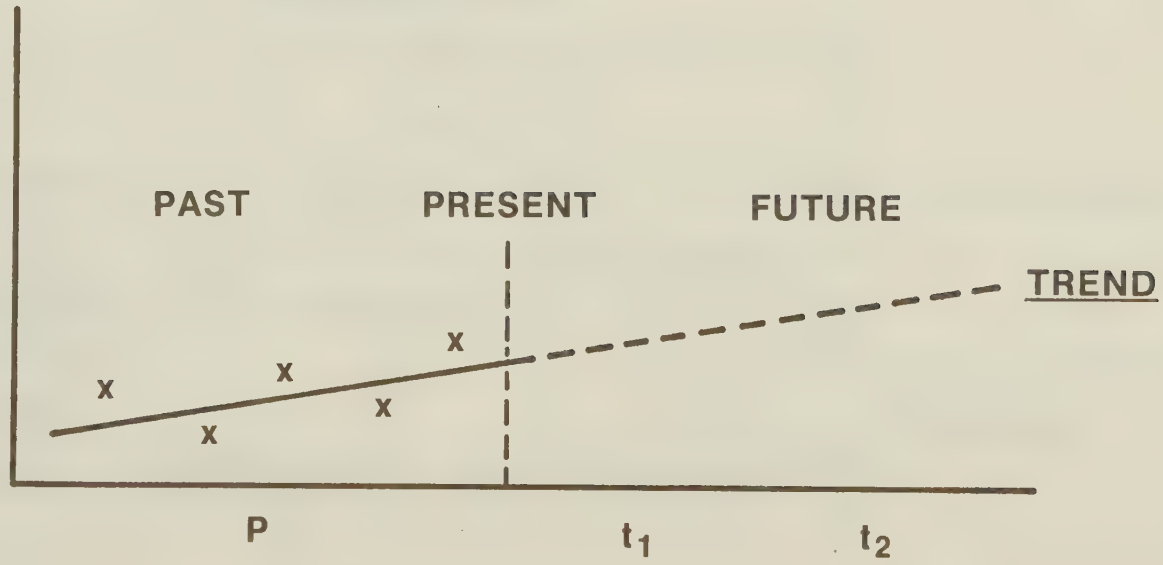
PHILOSOPHY	TOOLS	CHARACTERISTICS
CONCERNED ONLY WITH IMMEDIATE PROBLEM	NONE	LACK OF COMPREHENSIVENESS (MOST COMMON TYPE)

TREND PLANNING

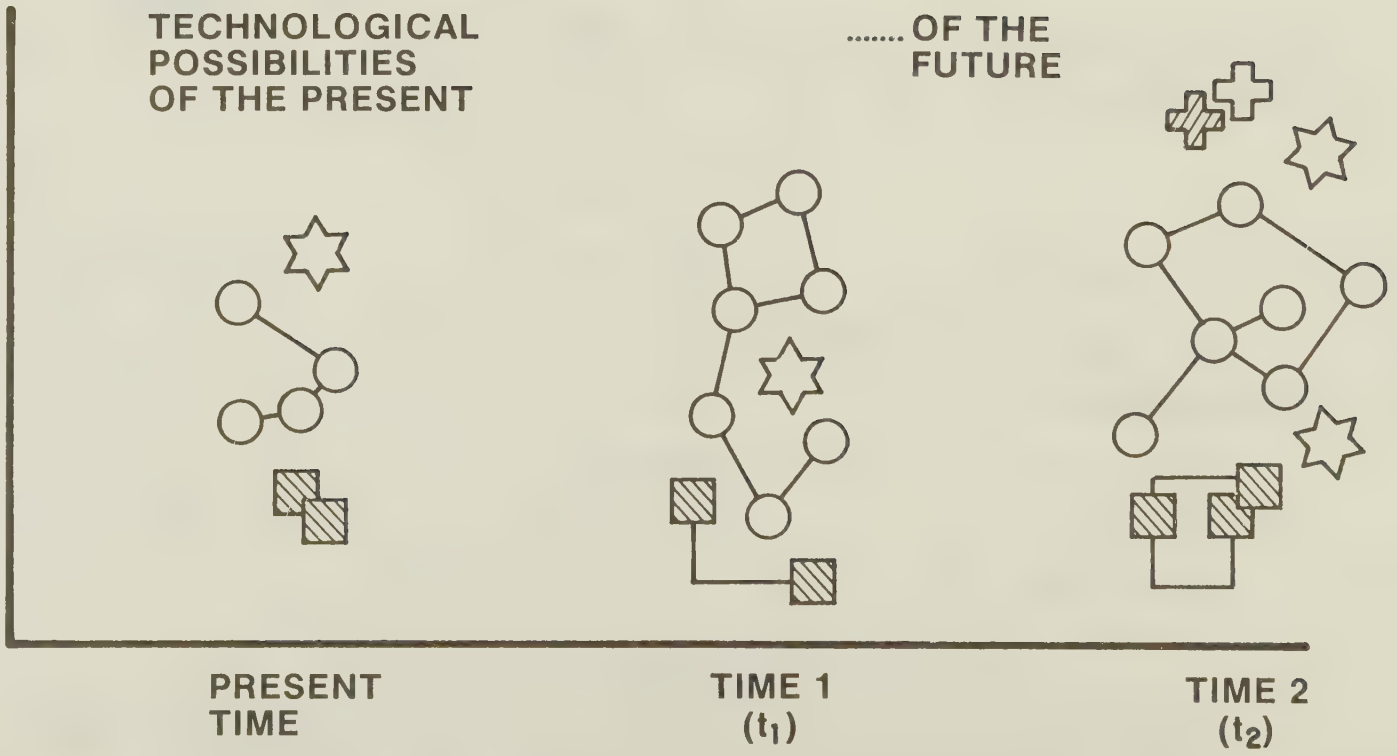


PHILOSOPHY	TOOLS	CHARACTERISTICS
FUTURE IS EXTENSION OF PAST	• TREND EXTRAPOLATION • MODELS BASED ON PAST	EMPHASIS ON DATA (SECOND MOST COMMON TYPE)

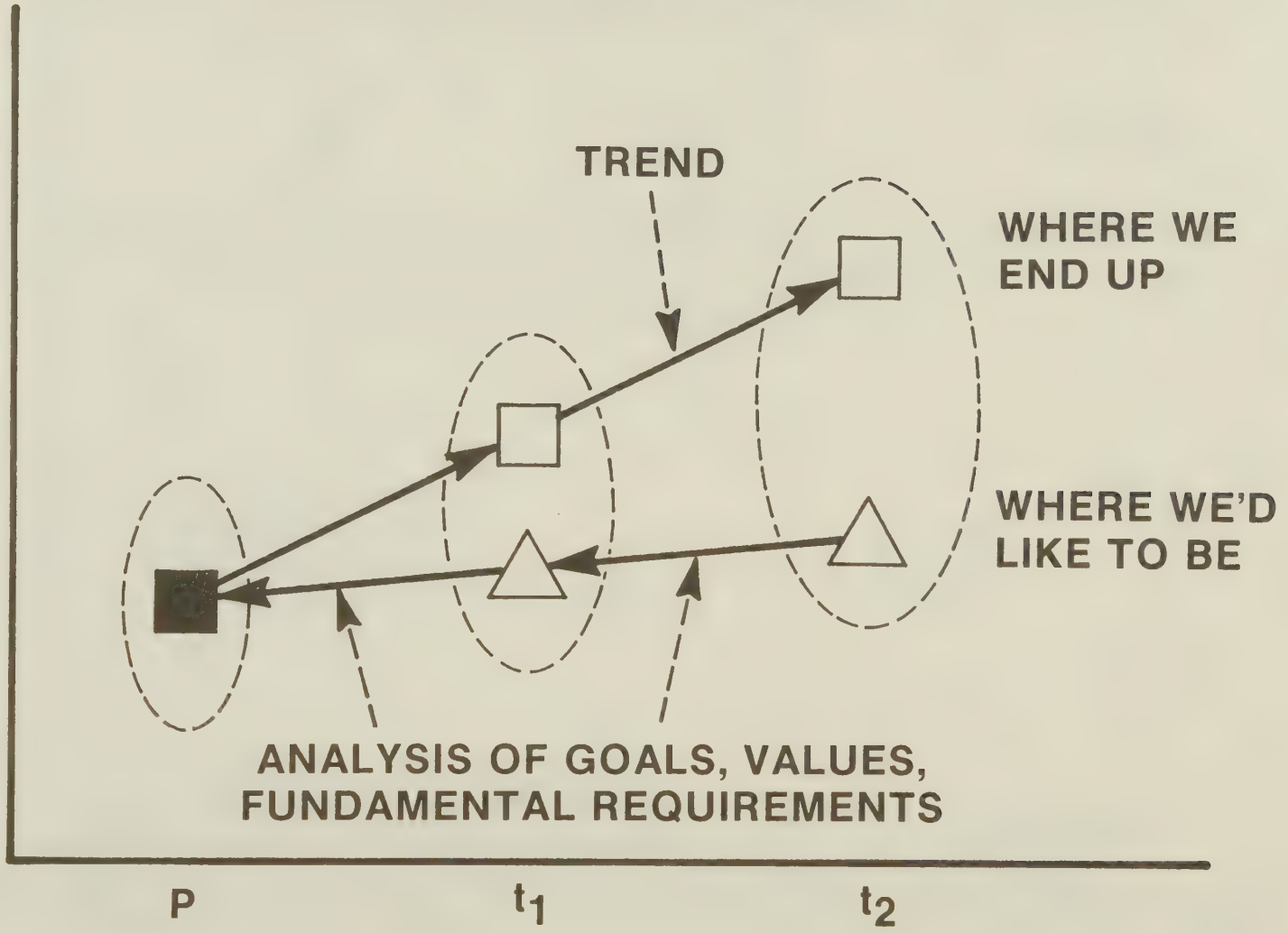
PROJECTION OF PAST TRENDS INTO THE FUTURE IGNORES EXPANSION OF TECHNOLOGICAL AND SOCIAL POSSIBILITIES



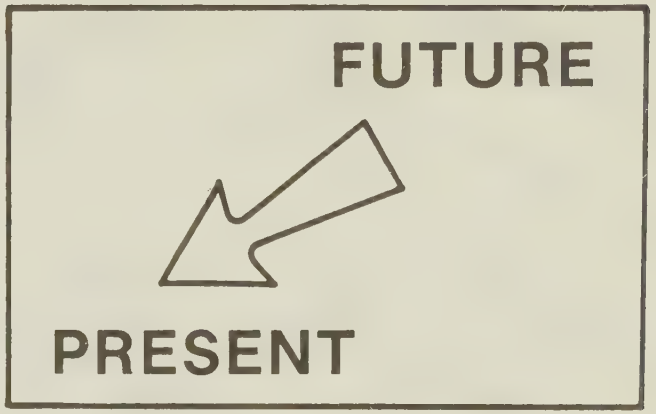
ASSUMPTION: MORE TECHNOLOGICAL POSSIBILITIES WILL BE AVAILABLE IN THE FUTURE BRINGING WITH THEM NEW SOLUTIONS TO OUR PROBLEMS . . . . . AND NEW PROBLEMS



ONE DANGER IN UTILIZING TRENDS FOR STRATEGIC PLANNING IS THAT FUTURE GOALS WILL BE PRE-ORDAINED BY THE PAST RATHER THAN SET BY VALUES AND DESIRABILITY

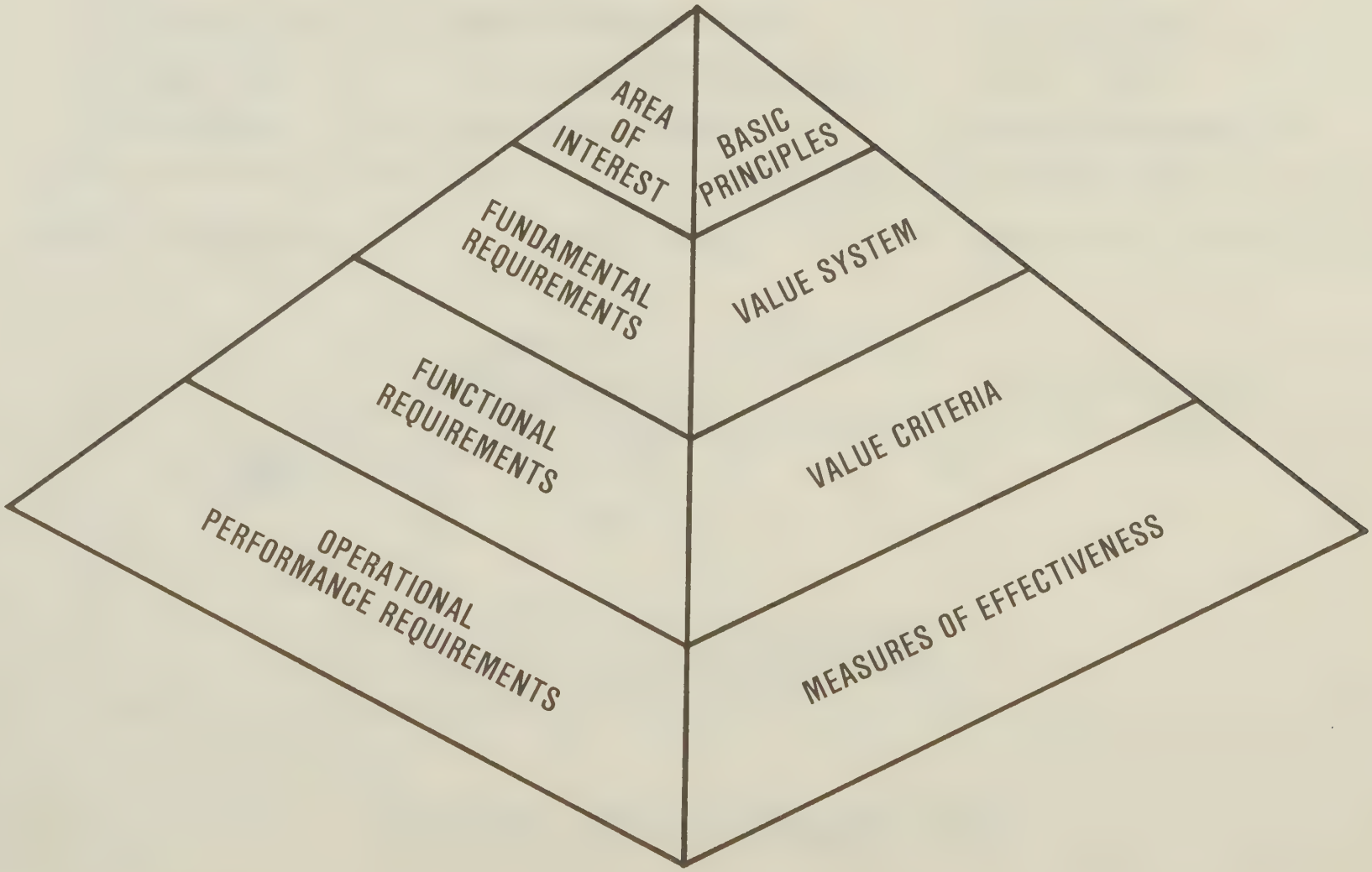


GOALS PLANNING

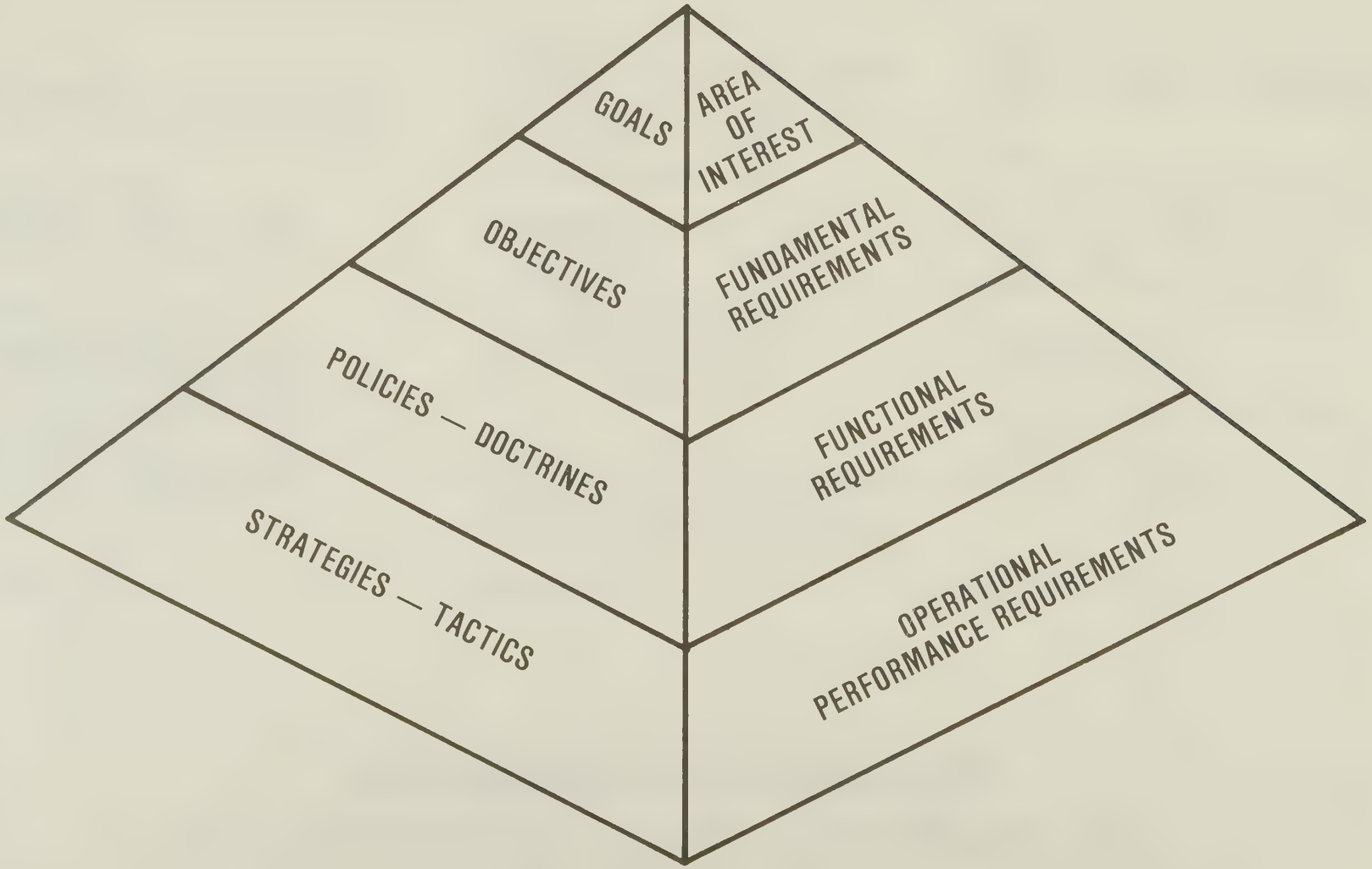


PHILOSOPHY	TOOLS	CHARACTERISTICS
FUTURE CAN BE CREATED	• NORMATIVE (NEEDS ANALYSIS) • IMAGINATION VISION	EMPHASIS ON VALUES CITIZEN INPUTS

SYSTEM REQUIREMENT — VALUE HIERARCHY



SYSTEM REQUIREMENT HIERARCHY



GOALS FOR THE FUTURE OF MARINE FISHERIES

GOAL:

RESTORE, MAINTAIN, ENHANCE AND UTILIZE IN A RATIONAL MANNER, FISHERIES RESOURCES OF IMPORTANCE TO THE UNITED STATES.

PART 1. CONSERVE AND MANAGE LIVING MARINE RESOURCES.

PART 2. CONSERVE, RESTORE AND ENHANCE FISH HABITATS.

GOAL:

DEVELOP AND MAINTAIN A HEALTHY COMMERCIAL FISHING INDUSTRY.

PART 3. DEVELOP AND MAINTAIN A HEALTHY COMMERCIAL FISHING INDUSTRY.

GOAL:

STRENGTHEN THE CONTRIBUTION OF MARINE RESOURCES TO RECREATION AND OTHER SOCIAL NEEDS.

PART 4. STRENGTHEN THE CONTRIBUTION OF MARINE RESOURCES TO RECREATION AND OTHER SOCIAL NEEDS.

GOALS:

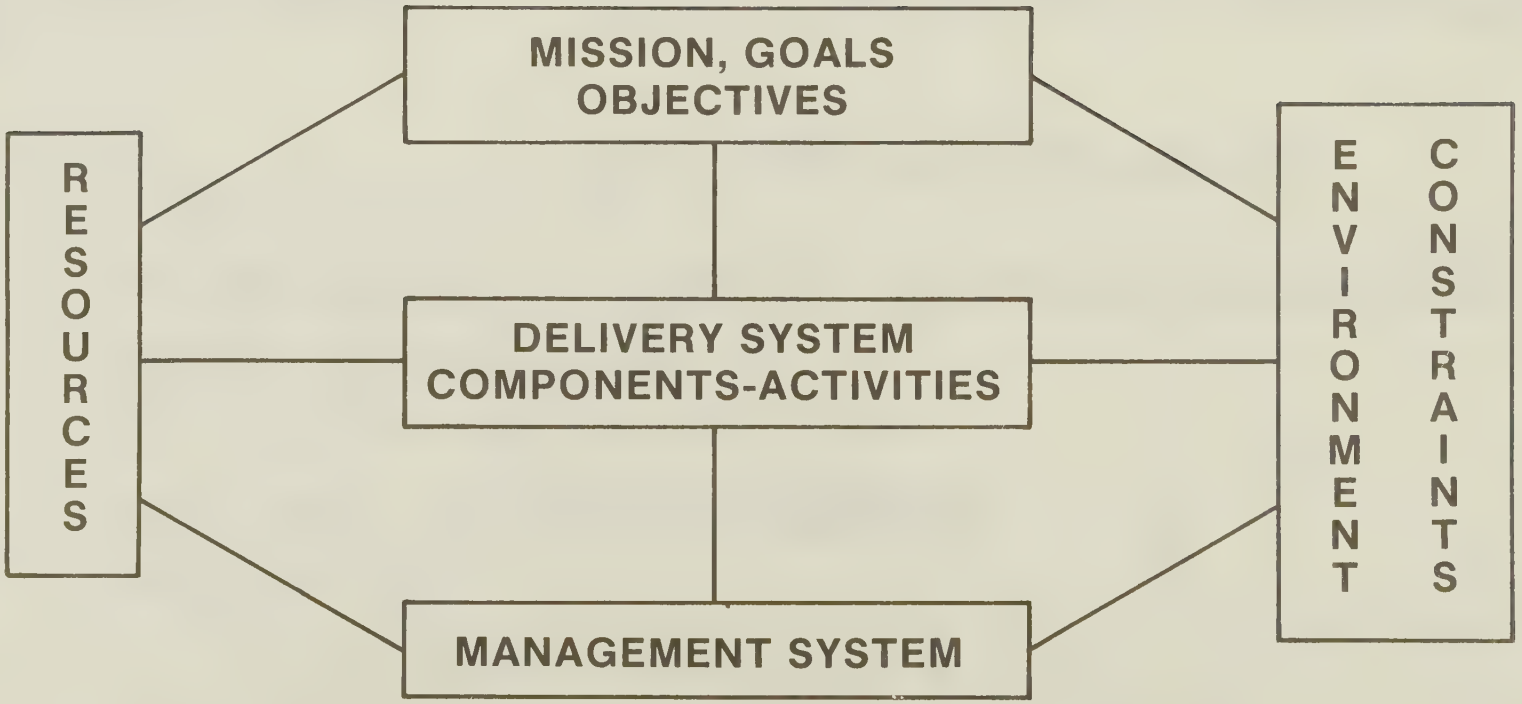
ENSURE ADEQUATE SUPPLIES OF WHOLESOME SEAFOOD PRODUCTS FOR CONSUMERS.

PART 5. ENCOURAGE THE DEVELOPMENT OF PUBLIC AND PRIVATE AQUACULTURE FOR SELECTED SPECIES OF FISH.

(DEVELOPING NATURAL FISH RESOURCES IS DEALT WITH IN PART 3.)

PART 6. ASSURE THE SAFETY, QUALITY AND IDENTITY OF THE SUPPLY OF SEAFOODS FOR U.S. CONSUMERS.

A SYSTEM VIEW OF AN ORGANIZATION



KEY TERMS

- MISSION — THE ULTIMATE PURPOSE OF THE ENTERPRISE.
- GOALS — QUALITATIVE STATEMENTS OF PURPOSE.
- OBJECTIVES — MEASURABLE STATEMENTS OF PURPOSE.

THE ENVIRONMENT OF A PROGRAM CONTAINS ALL THE CONSTRAINTS THAT MUST BE TAKEN INTO ACCOUNT IN PLANNING & OPERATIONS:

CONSTRAINT ID

DOES IT INFLUENCE SUCCESS OF PROJECT?

CAN WE DO ANYTHING ABOUT IT?

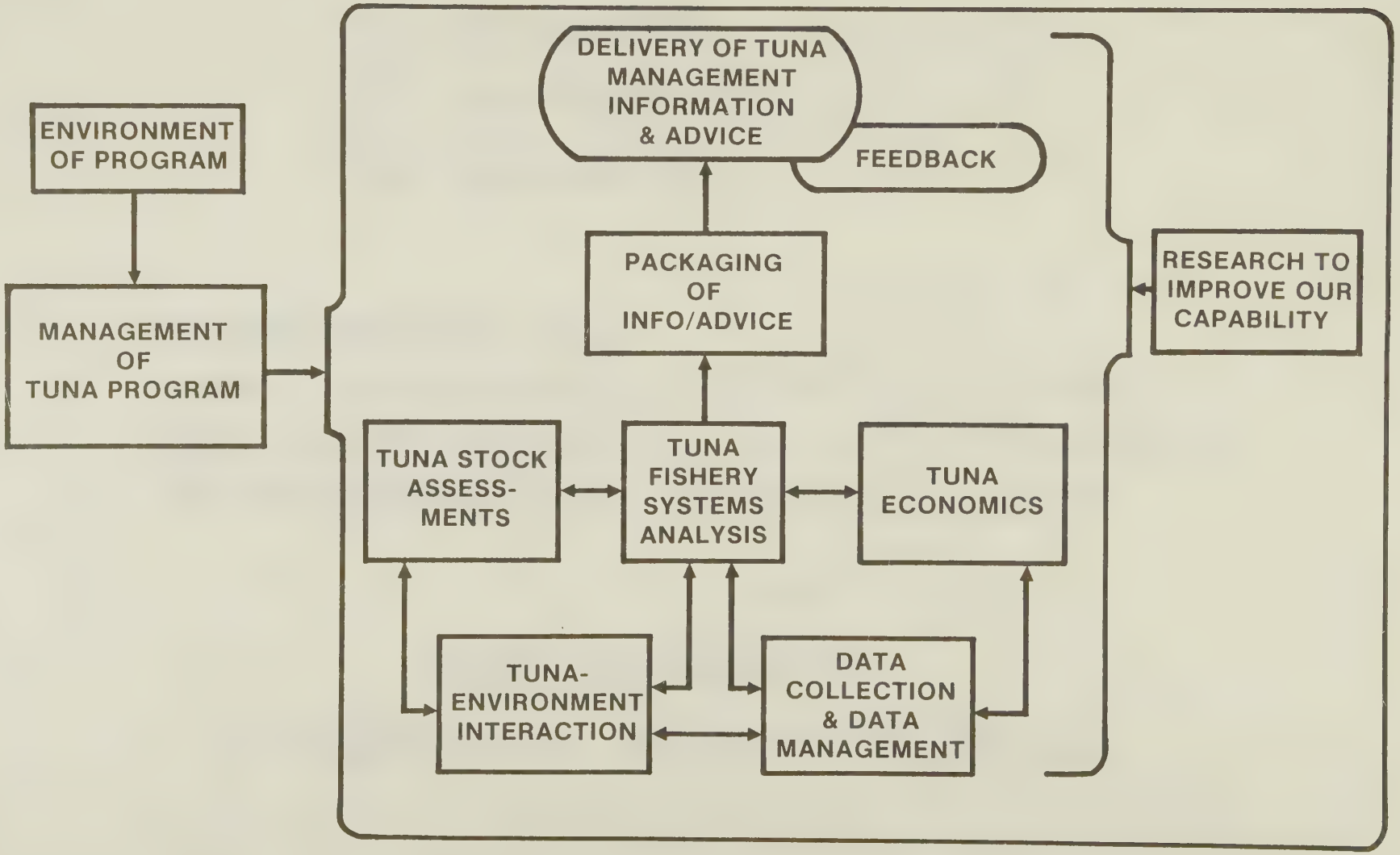
YES	NO
X	
	X

RESOURCES ARE PEOPLE AND THINGS THAT ARE USED TO ACCOMPLISH THE PROJECT~

FOR EXAMPLE:

- LABOR
- MATERIAL
- EQUIPMENT
- FUNDS
- INFORMATION

THE FUNCTIONAL MODEL OF THE SWFC's TUNA PROGRAM IS AN EXAMPLE OF A DELIVERY SYSTEM AND ITS COMPONENTS

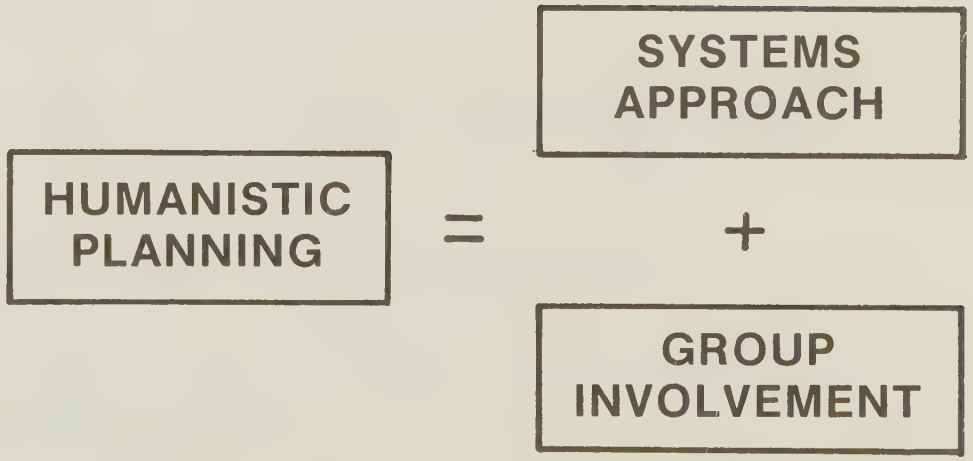


A GENERAL APPROACH TO MANAGEMENT

MANAGEMENT BY OBJECTIVES IS A GENERAL APPROACH TO MANAGEMENT THAT PROVIDES A FOUNDATION AND FRAMEWORK FOR:

(1) PLANNING
(2) ORGANIZING
(3) STAFFING
(4) DIRECTING AND LEADING
(5) EVALUATING

MODERN DAY PLANNING REQUIRES BOTH ANALYSIS & INVOLVEMENT OF THOSE WHO ARE EXPECTED TO CARRY OUT THE PLAN



BARRIERS TO CHANGE NEED TO BE ADDRESSED IN PLANNING

1. RIGIDITY.
2. VESTED INTERESTS
3. FEAR OF THE UNKNOWN.
4. LACK OF TRUST.
5. TECHNICAL OBSOLESCENCE.
6. WAITING FOR THINGS TO HAPPEN.

(MOST ARE PSYCHOLOGICAL)

SEVEN PHASES OF SOME TYPICAL FISHERY PROJECTS

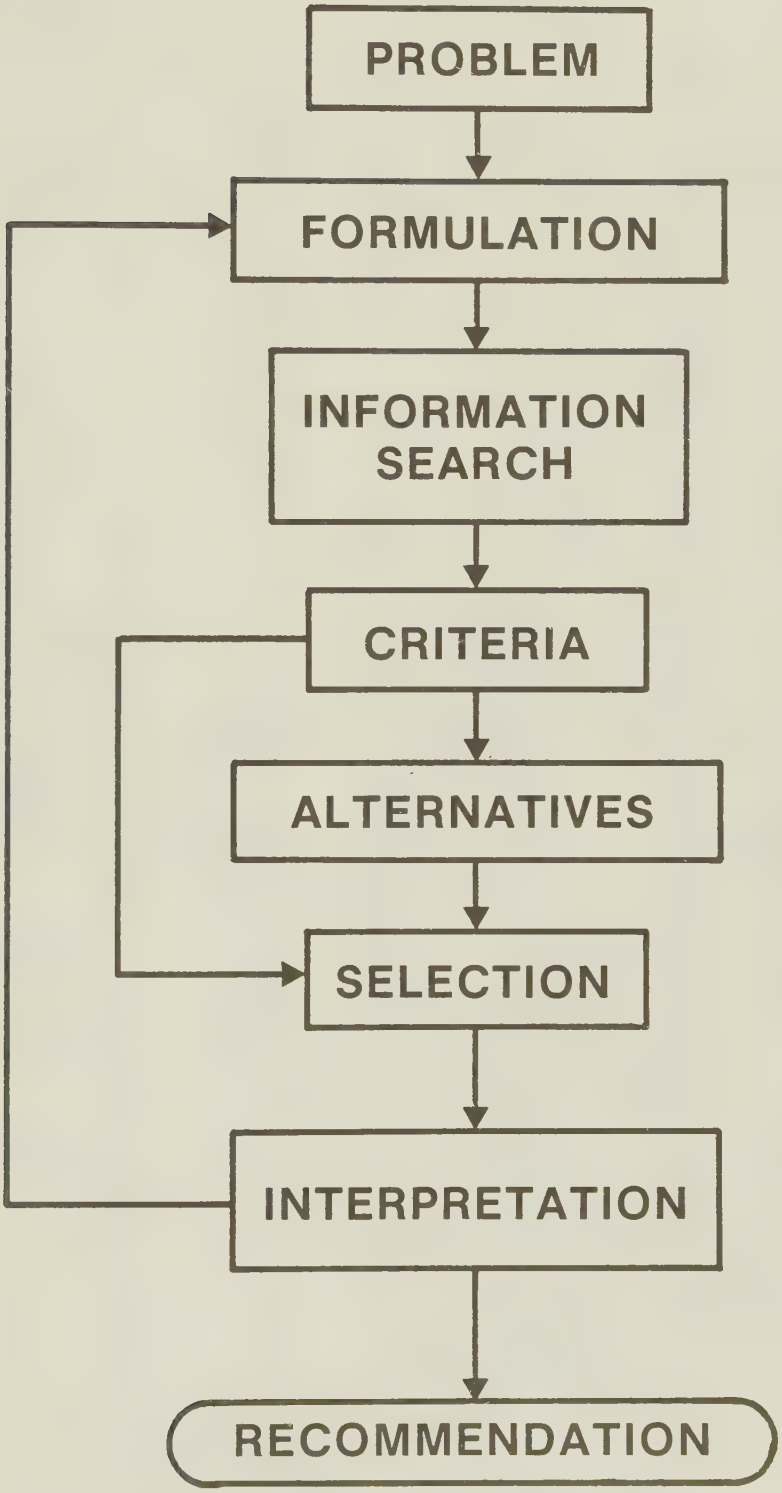
1. UNCRITICAL ACCEPTANCE
2. WILD ENTHUSIASM
3. DEJECTED DISILLUSIONMENT
4. TOTAL CONFUSION
5. SEARCH FOR THE GUILTY
6. PUNISHMENT OF THE INNOCENT
7. PROMOTION OF NON-PARTICIPANTS

A FRAMEWORK FOR THE IDENTIFICATION OF FORMS OF REJECTION

Form of Rejection	*Cause of Rejection*	*State of Subject*	*Anticipated Rejection Responses*
1. Ignorance	Lack of dissemination	Uninformed	"The information is not easily available."
2. Suspended judgment	Data not logically compelling	Doubtful	"I want to wait and see how good it is, before I try."
3. Situational	Data not materially compelling	1. Comparing	"Other things are equally good."
		2. Defensive	"The school regulations will not permit it."
		3. Deprived	"It costs too much to use in time and/or money."
4. Personal	Data not psycho-logically compelling	1. Anxious	"I don't know if I can operate equipment."
		2. Guilty	"I know I should use them, but I don't have time."
		3. Alienated (or estranged)	"These gadgets will never replace a teacher." ("If we use these gadgets they might replace us.")
5. Experimental	Present or past trials	Convinced	"I tried them once and they aren't any good."

Source: Eichholz and Rogers, 1964.

SYSTEMS ANALYSIS IS ONE OF THE MOST POWERFUL TOOLS OF PLANNING



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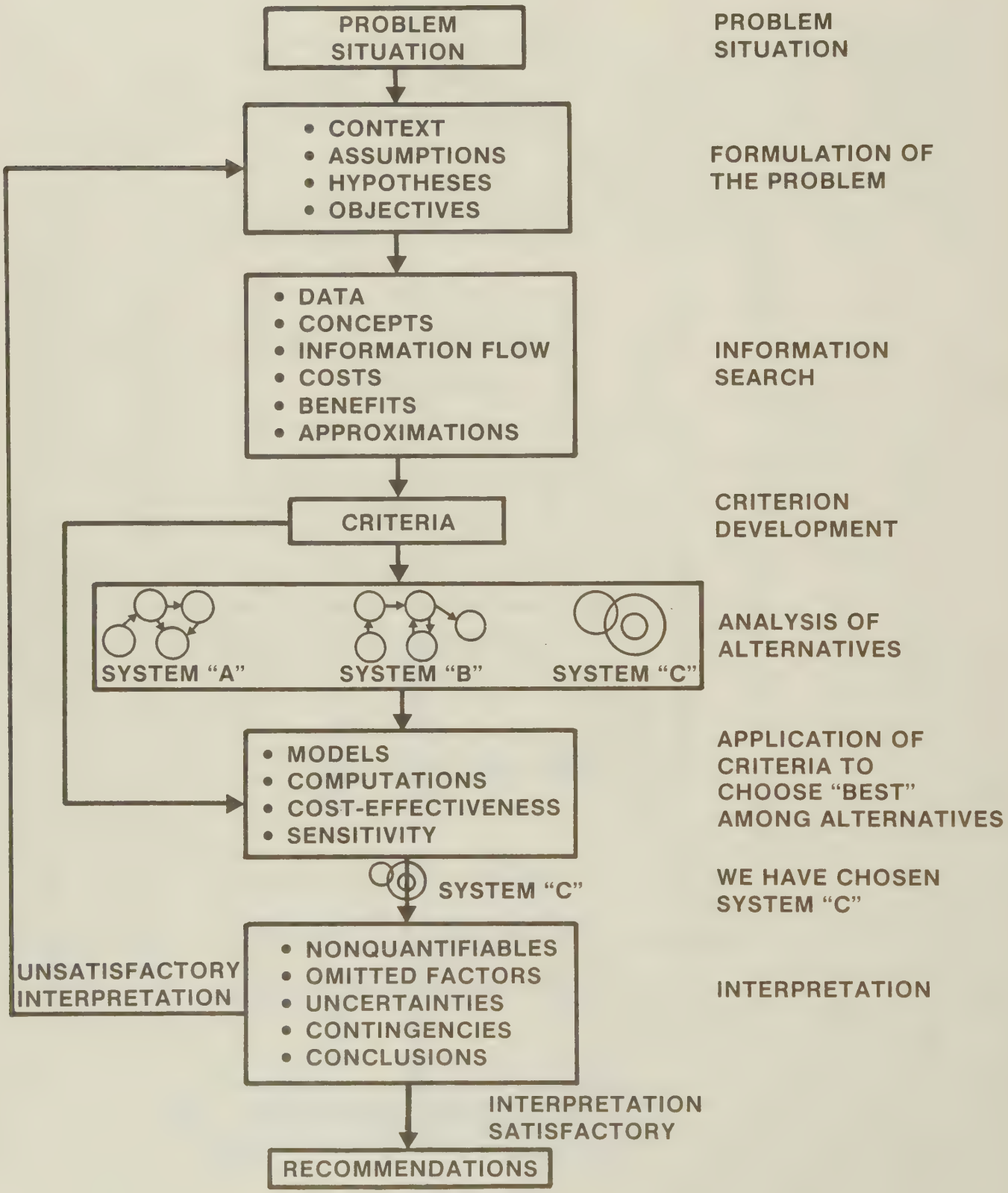


SYSTEMS ANALYSIS IS:

- A RESEARCH STRATEGY
- A PERSPECTIVE ON THE PROPER USE OF AVAILABLE TOOLS
- A PRACTICAL PHILOSOPHY OF HOW BEST TO AID A DECISION-MAKER WITH COMPLEX PROBLEMS OF CHOICE UNDER UNCERTAINTY

"System analysis is characterized as a systematic approach to helping a decision-maker choose a course of action by investigating his full problem, searching out objectives and alternatives, and comparing them in the light of their consequences, using an appropriate framework--in so far as possible analytic--to bring expert judgement and intuition to bear on the problem."

E.S. Quade and W.I. Boucher
The Rand Corporation
1968

A COMPARISON OF SYSTEMS ANALYSIS AND THE SCIENTIFIC METHOD

SYSTEMS ANALYSIS	SCIENTIFIC METHOD
• SUGGEST POLICIES	• SEEKS CONTRIBUTION TO KNOWLEDGE
• OFFERS ADVICE	
• PHILOSOPHIC VALUES APPLIED	• UNDERSTANDING
• IMMEDIATE, DIVERSE, COMPLEX, PRACTICAL PROBLEMS.	• PREDICTIVE CAPABILITY

EVEN THOUGH THE SYSTEMS ANALYSIS CONCEPT IS SIMPLE, IN PRACTICE THERE ARE MANY PROBLEMS STEMMING FROM . . . . . .

- No theoretical base for systems analysis nor policy planning
- Quantitative reasoning only partially helps — problems are not all amenable to mathematics
- Forced to rely on judgment

HOWEVER, THE APPROACH THAT MAKES IT POSSIBLE — *the essence of systems analysis* — IS TO CONSTRUCT AND THEN OPERATE WITHIN A MODEL.

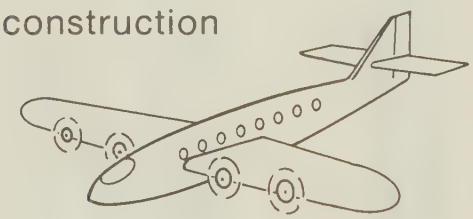
- **A MODEL IS AN IDEALIZATION OF THE SITUATION APPROPRIATE TO THE PROBLEM**

- **MODEL = FRAMEWORK + ANALYSIS**

A MODEL REPRESENTS REALITY AND ABSTRACTS THE FEATURES OF THE SITUATION —

ALL OF THESE CAN BE MODELS —

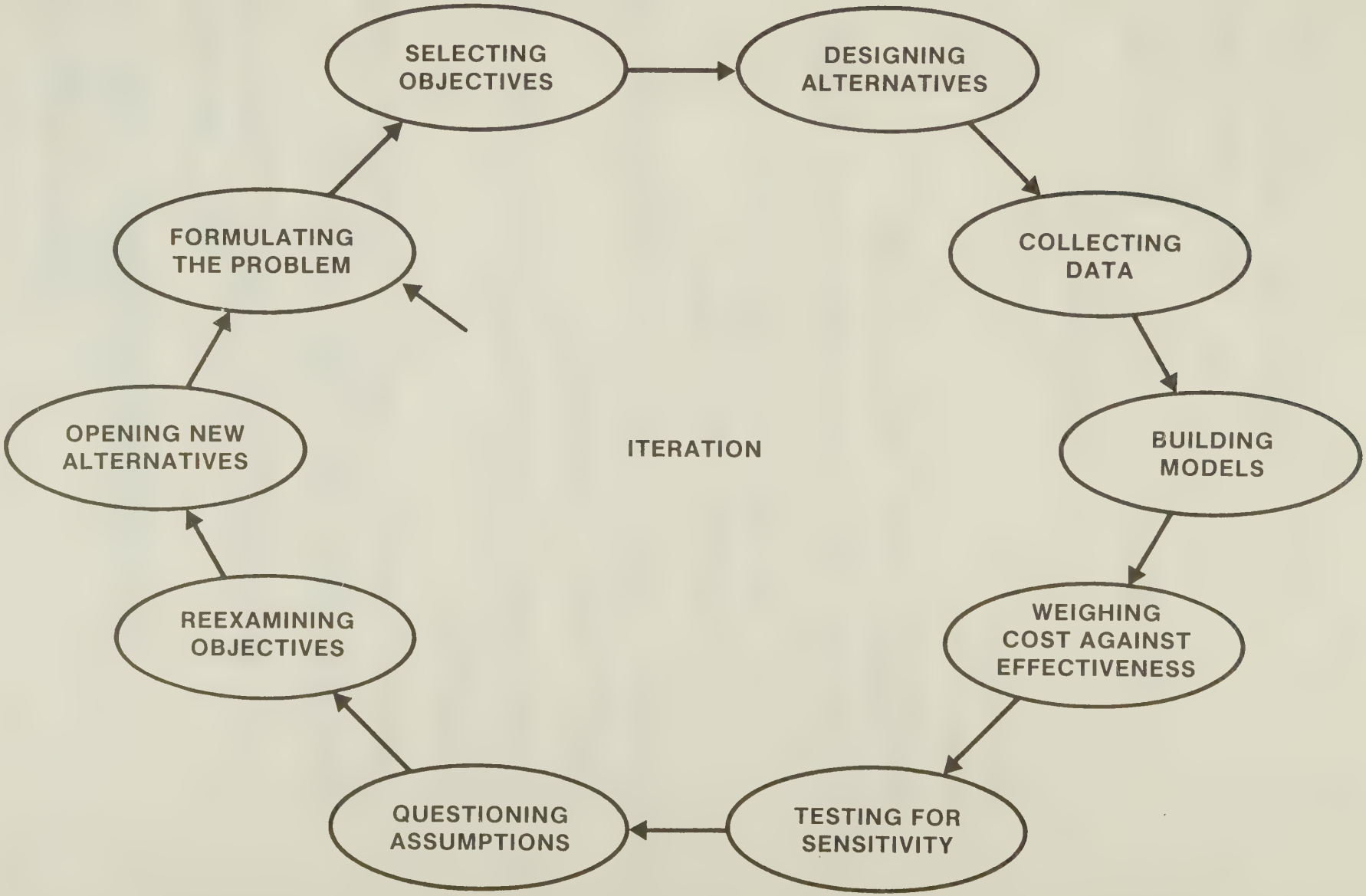
- A computer program.
- An equation
  $y = a + bx_2 + cx_2$
- A construction



- A written or verbal description
- A flow chart

MODELS ARE AN INDISPENSIBLE AID TO COMMUNICATION

A CONTINUOUS CYCLE UNTIL SATISFACTION IS OBTAINED OR TIME AND MONEY DEPLETED.



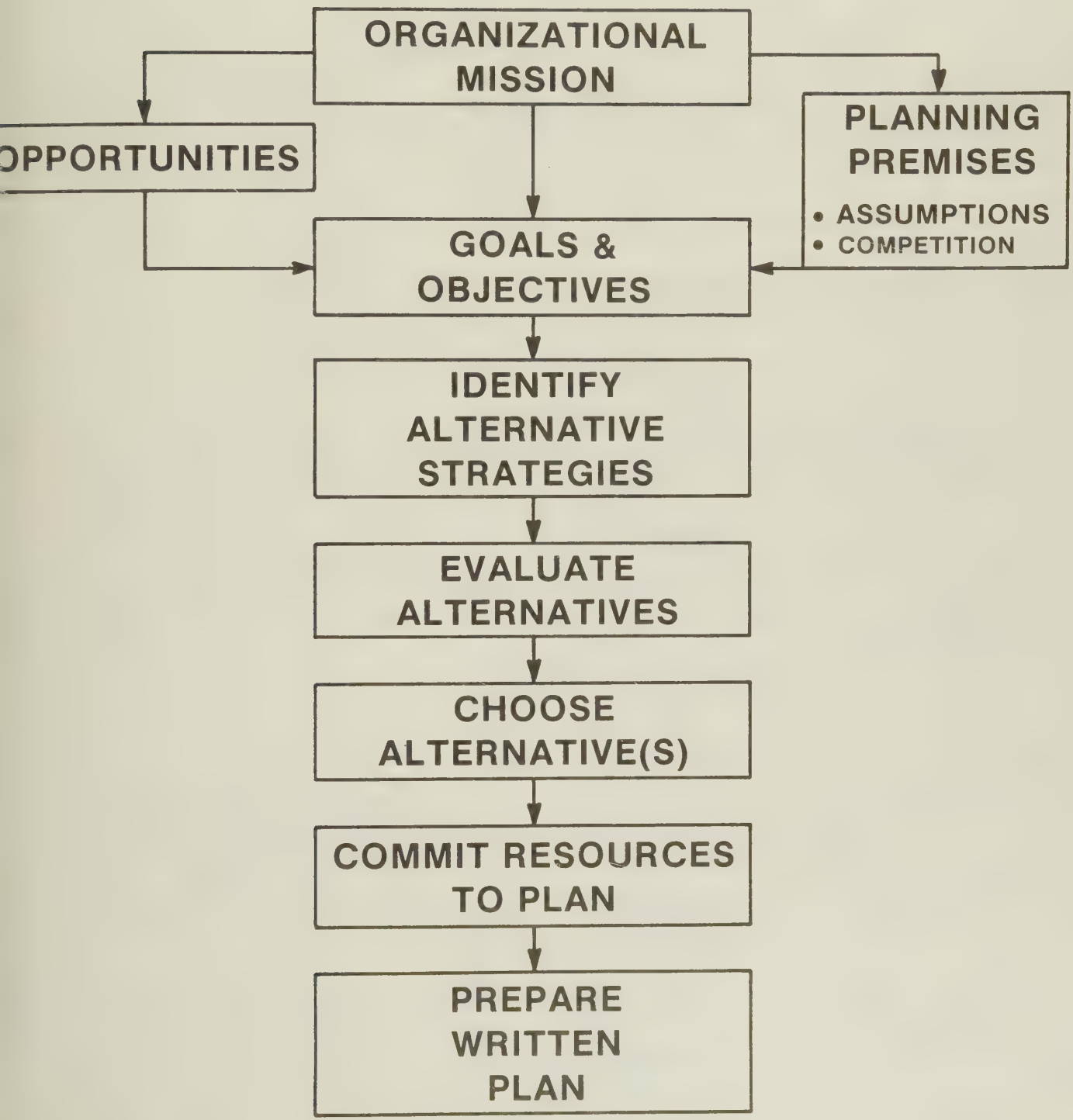
THE BASIC QUESTIONS OF PLANNING

1. WHERE ARE WE NOW?
2. WHERE DO WE WISH TO GO?
   - 5 YEARS GENERAL
   - 1 YEAR DETAIL
3. WHAT ARE THE DIFFERENT WAYS OF GETTING THERE?
4. HOW WILL WE KNOW WHEN WE ARE THERE?

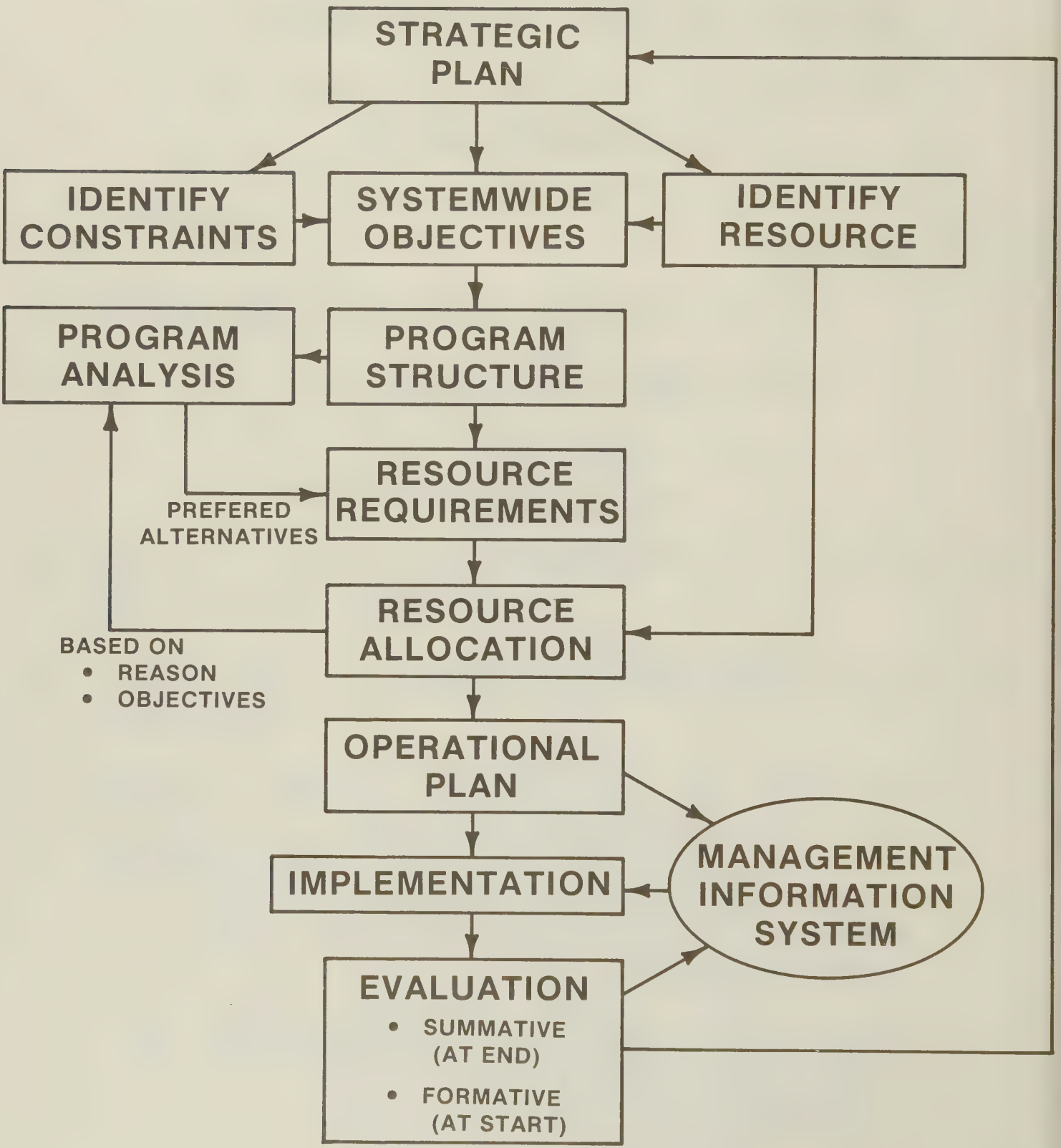
   (WHAT WILL I HAVE IN MY HAND WHEN WE'RE FINISHED?)

   - EFFECTIVE = ACCOMPLISH OBJECTIVE
   - EFFICIENT = WISE USE OF RESOURCES

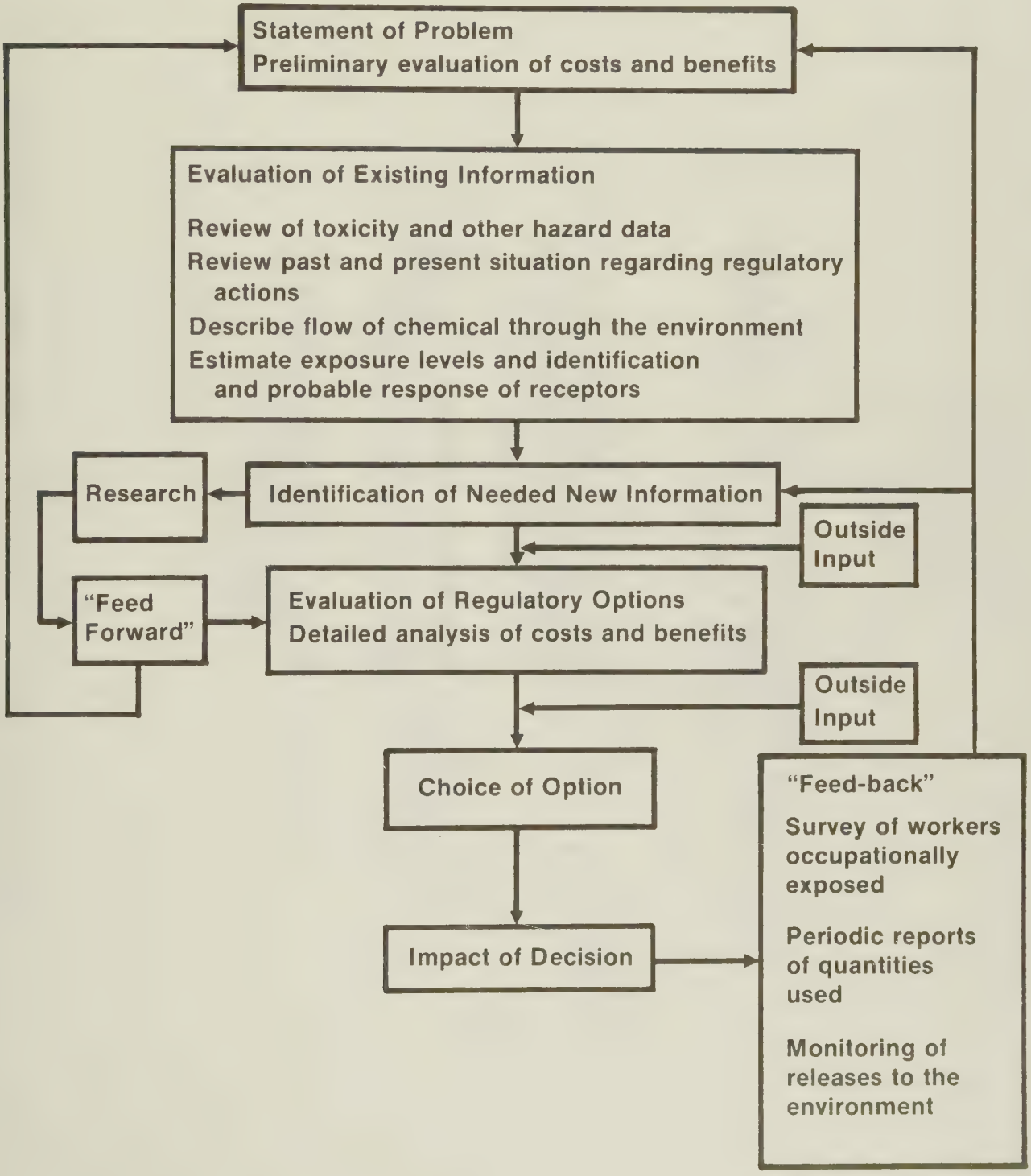
A PROCEDURE FOR STRATEGIC PLANNING



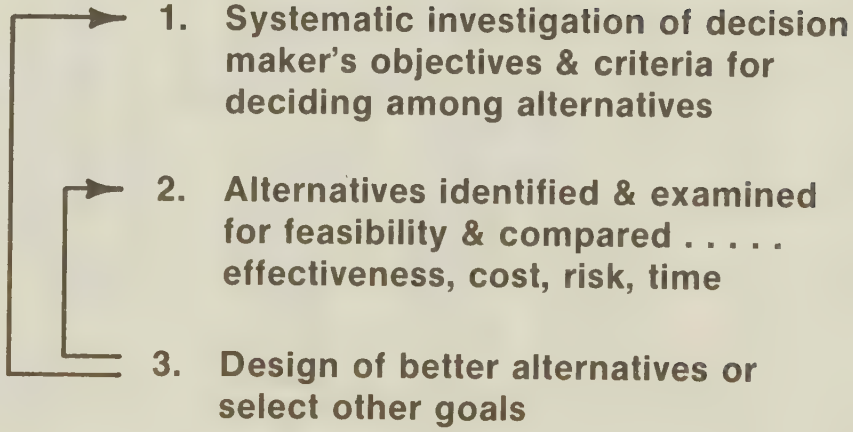
A PROCEDURE FOR TACTICAL PLANNING



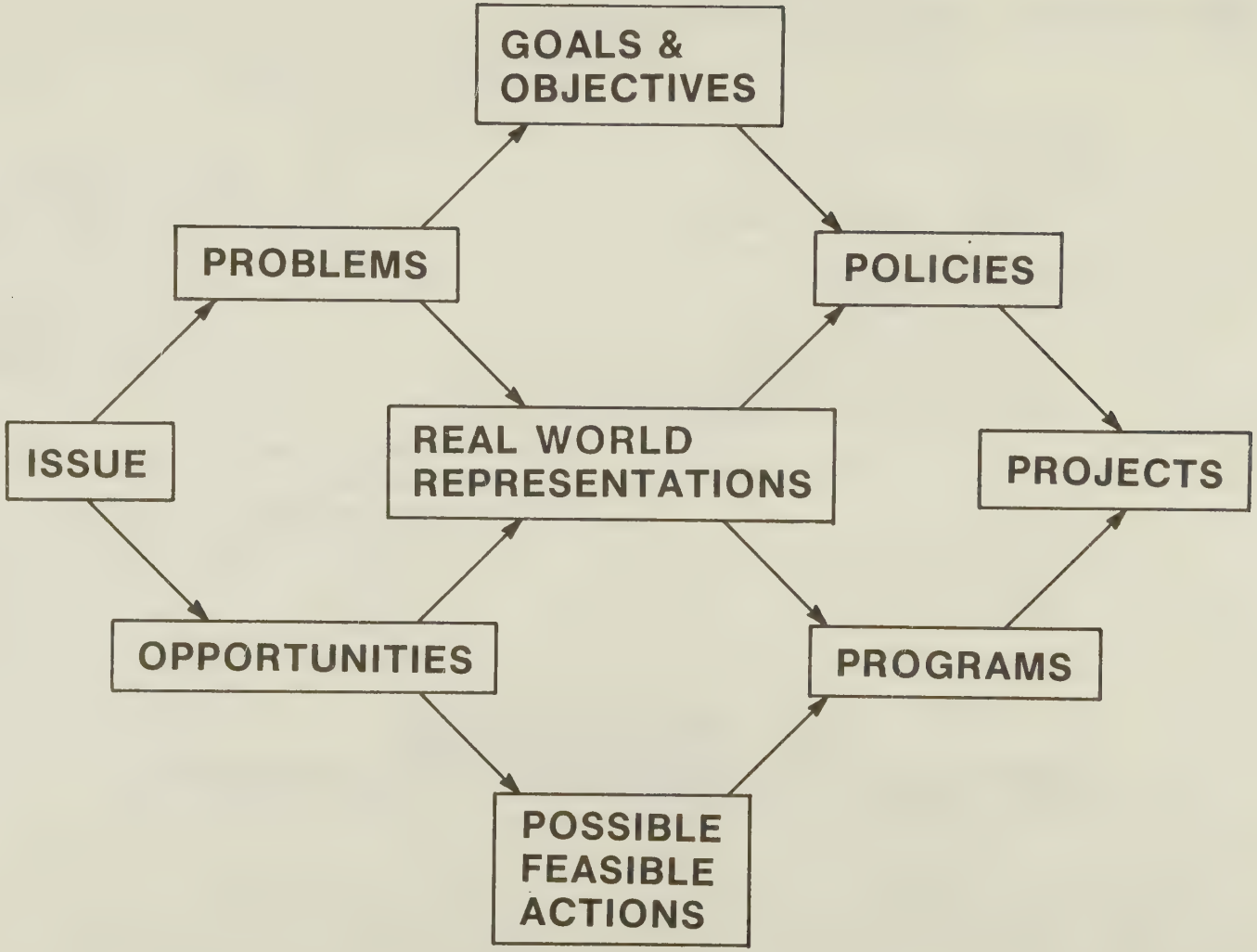
Sequence of steps for nonroutine decision making for regulating chemicals in the environment from National Academy of Sciences for EPA, 1975.


Statement of Problem
Preliminary evaluation of costs and benefits
Evaluation of Existing Information
Review of toxicity and other hazard data
Review past and present situation regarding regulatory actions
Describe flow of chemical through the environment
Estimate exposure levels and identification and probable response of receptors
Research
Identification of Needed New Information
Outside Input
"Feed Forward"
Evaluation of Regulatory Options
Detailed analysis of costs and benefits
Outside Input
Choice of Option
Impact of Decision
"Feed-back"
Survey of workers occupationally exposed
Periodic reports of quantities used
Monitoring of releases to the environment

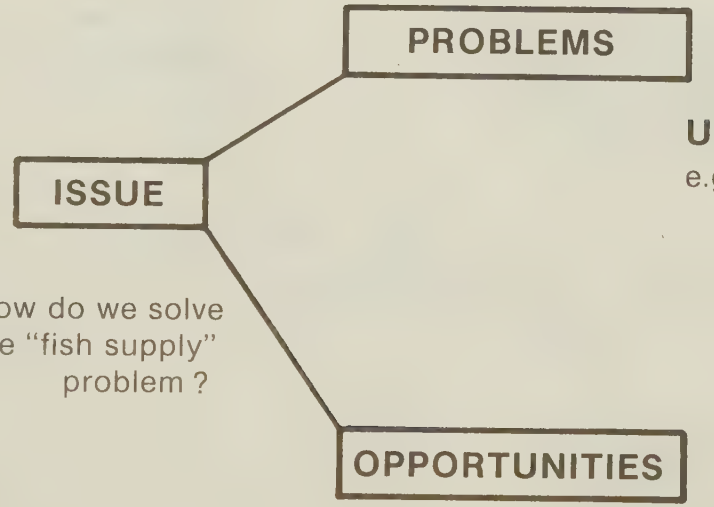
IN SYSTEMS ANALYSIS — THREE TYPES OF INQUIRY ARE REQUIRED


1. Systematic investigation of decision maker's objectives & criteria for deciding among alternatives
2. Alternatives identified & examined for feasibility & compared . . . . . effectiveness, cost, risk, time
3. Design of better alternatives or select other goals

COMPLEX POLICY PROBLEMS (ISSUES) CAN BE ANALYZED AND PROJECTS FORMED TO SOLVE OR MITIGATE THEM



ISSUES CAN BE EXPRESSED AS PROBLEMS AND OPPORTUNITIES



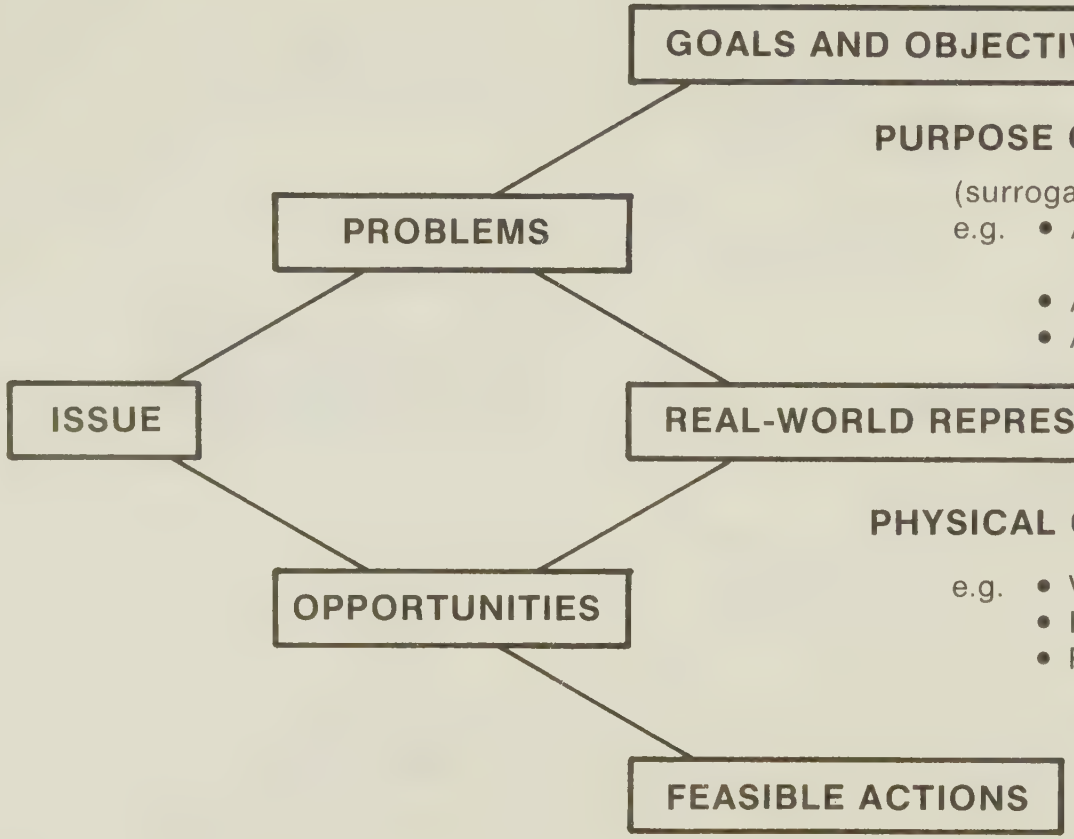
UNDESIRABLE SITUATIONS:

e.g.
- Price fuel increasing
- Foreign vessels competing
- Stocks decreasing
- Technology backward
- Efficiency & quality lacking

RESOURCES AVAILABLE OR EMERGING

e.g.
- SK funding
- Alaska resources available
- Vessel design improvements

THE REAL-WORLD MUST GUIDE THE SETTING OF REALISTIC GOALS AND THE ASSESSMENT OF FEASIBLE ACTION



PURPOSE OR PREFERENCE

(surrogates for value statements)

e.g.
- Achieve self sufficiency in fish supply
- Adopt conservation measures
- Avoid a fish-OPEC

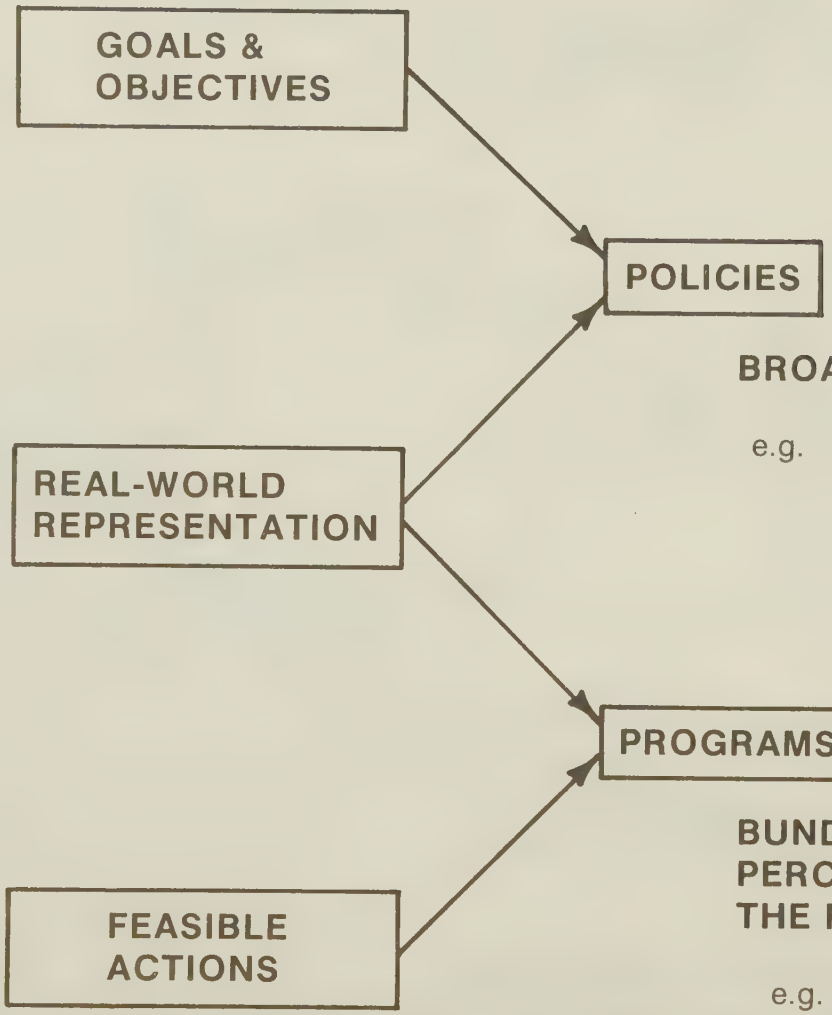
PHYSICAL OR SOCIAL REALITY

e.g.
- Volume imported
- Inventory of resources
- Production levels

THINGS THAT COULD BE DONE

e.g.
- Subsidize exploration
- Manage fish stocks better
- Protect habitat

POLICIES & PROGRAMS, ALSO BASED ON THE REAL WORLD, SET THE GUIDELINES FOR RESOLVING THE ISSUE



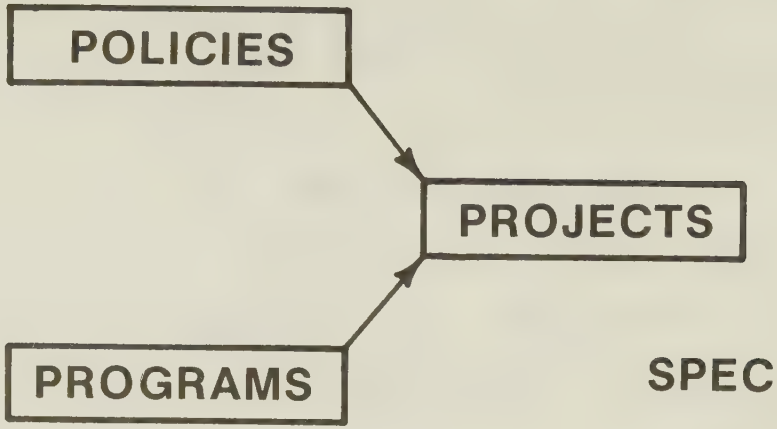
BROAD STATEMENTS OF INTENT

e.g. • Have clearly stated fishery stock conservation strategies for U.S. & International resources

BUNDLES OF ACTIONS WHICH ARE PERCEIVED AS BEING INSTRUMENTAL TO THE REALIZATION OF POLICIES

e.g. • Gov't funding of foundation's projects
• Management councils & fishery management plan implementation
• Negotiations with foreign governments to ensure supply of U.S. caught fish

PROJECTS ARE THE SPECIFIC ACTIONS WHICH RESOLVE THE ISSUE...



SPECIFIC ACTIONS

e.g.
- Develop & implement groundfish management plan
- Fund development project XYZ from the ABC foundation
- Negotiate international tuna fishery management regime

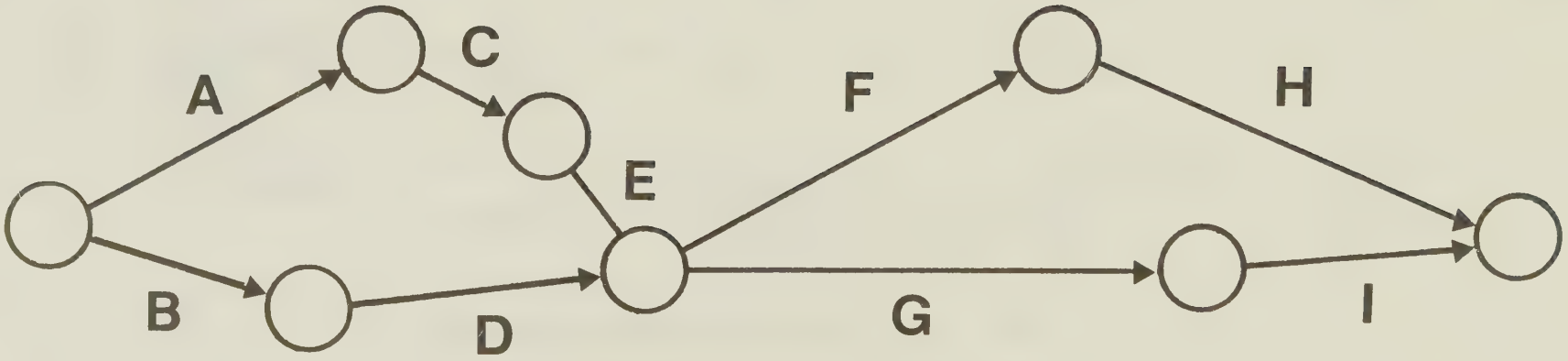
NETWORK ANALYSIS:

(C.P.M. ~ CRITICAL PATH METHOD
PERT ~ PROGRAM EVALUATION & REVIEW TECHNIQUE)

IS A PLANNING TOOL FOR

1. SPECIFYING ACTIVITIES
2. SCHEDULING ACTIVITIES & RESOURCES
3. CONTROLLING COSTS & TIME ON PROJECTS

A NETWORK SHOWS THE LOGICAL SEQUENCE OF PROJECT ACTIVITIES



A SMALL PROJECT

*(solution to a problem)

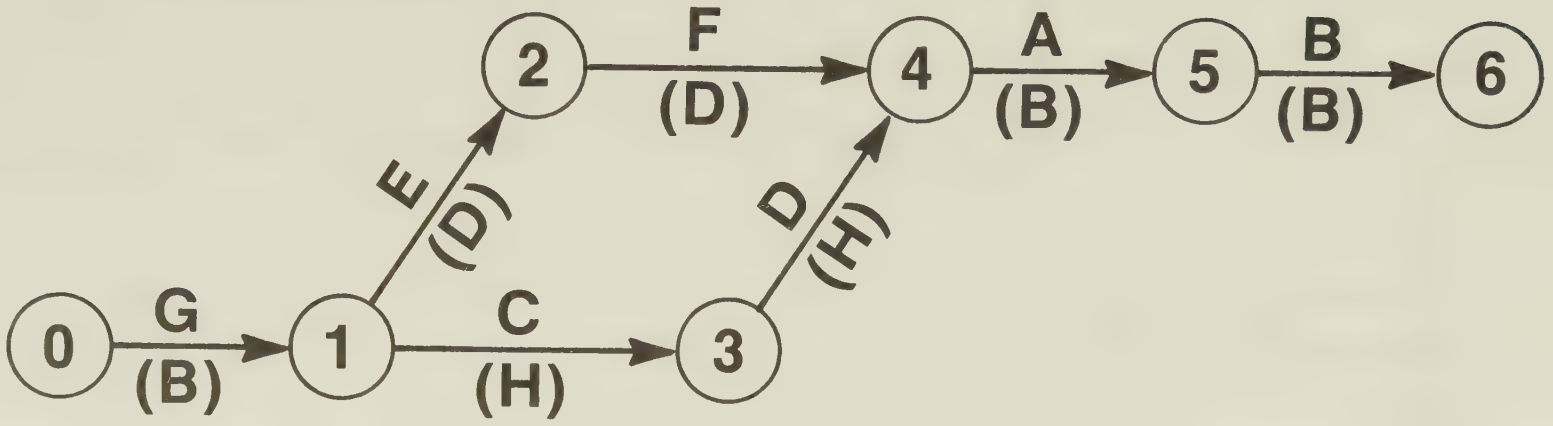
A trip to Magdalena Bay to sample the fish catch.

H = Hector D = Daniel B = Both

Activity	Responsibility	Depends on:	Duration (Min.)
A. Load car	B	F	5
B. Drive to Magdalena Bay	B	A	60
C. Get money from bank	H	G	10
D. Purchase gasoline	H	C	10
E. Gather equipment	D	G	15
F. Inspect & calibrate equipment	D	E	15
G. Decide on trip	B	—	2

*Assumptions: 1. Hector has no money, 2. The car cannot be loaded until the equipment is inspected & calibrated.

A TRIP TO MAGDALENA BAY TO SAMPLE CATCH



ACTIVITY (LOGIC) NETWORK

G. DECIDE ON TRIP

E. GATHER EQUIPMENT

C. GET MONEY FROM BANK

F. INSPECT & CALIBRATE EQUIPMENT

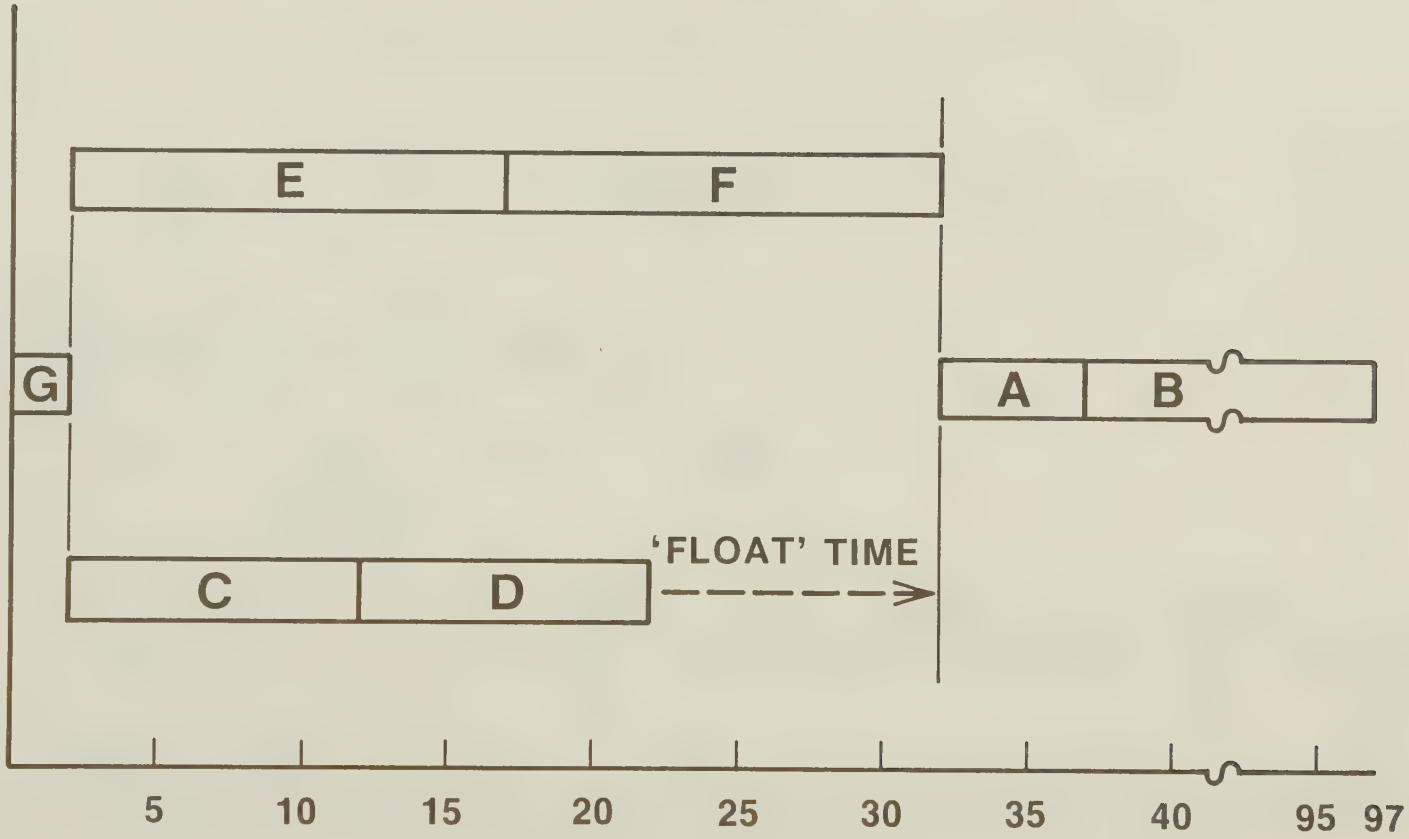
D. BUY GASOLINE

A. LOAD CAR

B. DRIVE TO BAY

A TRIP TO MAGDALENA BAY

ACTIVITIES SCHEDULED IN "EARLY START" POSITION



APPENDICES

A PROJECT MANAGEMENT SYSTEM*

1. **DEFINE PROJECT**
   - *What*
   - *Why*
   - *How*
   - *Where*
   - *When*
   - *How much ($)*
   - *Who*
2. *Breakdown into logical* **SUB-PROJECTS**
   - *Time*
   - *Geography*
   - *Physical units...whatever makes sense*
3. *List organizational* **RESPONSIBILITIES** *for each sub-project*
   - *Who is in charge?*
   - *List resources*
4. *Prepare* **LIST OF ACTIVITIES**
   - *First select level of detail*
5. **ESTIMATE DURATION** *of each activity*
   - *Best estimate...not deadline*
6. **PREPARE NETWORK**--*then* **BAR-CHART** *(scheduled)*
   - *Time-scaled diagram*
7. **REVIEW, EVALUATION & DECISION** *by management*
   - *Look at overall schedule*
   - *Resource use*
   - *Time estimates*
8. **DISTRIBUTE** *schedule &* **EXECUTE** *assignments*
   - *Include bar chart that tells who does what and when*
9. **UPDATE** *network diagram to show completion*
   - *Establish reporting period*
10. **RE-PLAN & RE-SCHEDULE** *when necessary*
11. **MAKE COPY** *of updated/revised plan & distribute*
12. **EXECUTE ASSIGNMENTS** *on new schedule*

*FROM PLANALOG CORP.

SOME ATTRIBUTES OF GOOD OBJECTIVES:

- SINGLE KEY RESULT
- DATE
- SPECIFIC
- VERIFIABLE
- QUANTIFIABLE

  "WHAT & WHEN"

  NOT "WHY & HOW"

- RELATES TO MANAGER ROLE
- EASILY UNDERSTOOD
- CONSISTENT WITH RESOURCES
- AGREED TO BY
- COMMUNICATED
- REFERRED TO

WHY IS A FRAMEWORK OF TOPICS NEEDED?

- MATERIAL NEEDS TO BE ORGANIZED TO BE USEFUL
- REACH CONCLUSIONS ABOUT EACH CLASSIFICATION
- CONCLUSIONS VALID & SIGNIFICANT
- INDICATES LIMITS OF WHERE FINDINGS APPLY
- CONCLUSIONS CAN APPLY TO NEW PROBLEMS WITHIN FRAMEWORK
- COMMUNICATIONS ARE DIFFICULT NAMES/DEFINITIONS VARY

PRINCIPLES OF PLANNING (Koontz and O'Donnell)

1. THE PURPOSE OF EVERY PLAN IS TO FACILITATE THE ACCOMPLISHMENT OF ENTERPRISE OBJECTIVES.
2. LOGICAL PLANNING COVERS A PERIOD OF TIME IN THE FUTURE NECESSARY TO FORESEE, THROUGH A SERIES OF ACTIONS, THE FULFILLMENT OF COMMITMENTS INVOLVED IN A DECISION.
3. PLANNING LOGICALLY PRECEDES THE EXECUTION OF ALL OTHER MANAGERIAL FUNCTIONS.
4. THE EFFICIENCY OF A PLAN IS MEASURED BY THE AMOUNT IT CONTRIBUTES TO OBJECTIVES OFFSET BY THE COSTS REQUIRED TO FORMULATE AND OPERATE IT.
5. INDIVIDUALS CHARGED WITH PLANNING MUST UNDERSTAND ORGANIZATIONAL POLICIES AND CONSTRAINTS.
6. INDIVIDUALS CHARGED WITH PLANNING MUST AGREE TO UTILIZE CONSISTENT PLANNING PREMISES (i.e., ASSUMPTIONS STATED WITH REASONS WHY. . . .
7. A "SYSTEMS VIEW" OF THE ORGANIZATION AND ITS ENVIRONMENT (PRESENT AND PROJECTED) IS ESSENTIAL FOR SUCCESSFUL PLANNING.
8. IT IS IMPORTANT THAT THOSE WHO WILL IMPLEMENT THE PLANS BE INVOLVED IN DEVELOPING THE PLANS.
9. A GOOD PLAN WILL BE A BLEND OF DEFINITE COMMITMENTS AND FLEXIBILITY.
10. PLANS MUST BE REDRAWN DURING THE PERIOD OF IMPLEMENTATION AS APPROPRIATE.

SOME USEFUL METHODOLOGIES OR STUDY TECHNIQUES APPLICABLE TO ELEMENTS OF A COMPREHENSIVE TECHNOLOGY ASSESSMENT

Study techniques	Structuring the problem	The systems alternatives	Possible impacts	Evaluating impacts	Identifying decision makers	Identifying possible action options for decision makers	Parties at interest	Macro systems alternatives	Exogenous variables state of society	Conclusions and recommendations	Participation of parties at interest	Presentation of results
Historical surveys	•	•	•		•	•	•	•	•	•		•
Input/output	•			•			•					•
Compilation of prior work	•	•	•	•	•	•	•	•	•	•		•
Cost-benefit	•			•			•					•
Systems analysis	•	•	•	•		•	•	•				
Risk-benefit	•			•			•					•
Systems engineering	•	•	•					•				
Simulation	•	•	•	•			•		•		•	•
Expert panels, workshops	•	•	•	•	•	•	•	•	•		•	•
Modeling	•	•	•	•			•		•		•	•
Hearings	•	•	•		•	•	•	•	•	•	•	•
Interpretive structural modeling	•				•		•			•	•	•
Field or on-site investigation	•		•	•	•		•				•	
Signed digraph	•		•	•	•	•						•
Trend extrapolation and analysis			•	•					•			
Physical models			•	•								•
Delphi	•	•	•	•	•	•	•	•	•		•	
Scenarios/games	•	•	•	•	•	•		•	•	•	•	•
Cross impact	•	•	•	•		•			•			
Moot courts			•	•	•	•	•			•	•	•
Check lists	•	•	•		•	•	•					•
Telecommunication participation			•	•	•	•	•		•	•	•	•
Morphological analysis	•	•						•				
Syncons			•	•	•	•	•	•	•	•	•	•
Historical analogy	•		•	•	•	•	•		•	•		
Survey techniques				•			•		•	•	•	•
Decision/relevance tree	•	•	•	•	•	•						•
Ballots				•			•		•	•	•	•
Fault tree	•		•	•								•
Decision theory				•		•				•		•
Scaling				•					•	•		•
Brainstorming	•	•	•		•	•	•	•	•	•	•	
Graphics				•							•	•
Judgment theory				•		•				•		
Dynamic modeling	•	•	•	•					•	•		•
KSIM	•	•	•	•				•	•	•	•	•

FROM: TECHNOLOGY ASSESSMENT - A TOOL KIT, Joseph F. Coates, CHEMTECK, 1976